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GB 1577034 A

(58) Field of search
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(54) **Blow mould having cooling channels**

(57) A blow-mould has an outer shell (2) defining a chamber, and an inner shell (4) receivable and locatable within the chamber and whose inner surface (12) defines with neck and base inserts (56, 64, 68) the mould cavity. The inner shell (4) is formed with open cooling fluid channels (14) in its external surface, and the outer shell (2) is arranged to close off the channels so as to define with the inner shell a path for cooling fluid to flow through the mould.

Alternatively, the inner surface of outer shell (2) may be formed with open cooling fluid channels which are in addition to, or instead of the channels (14).

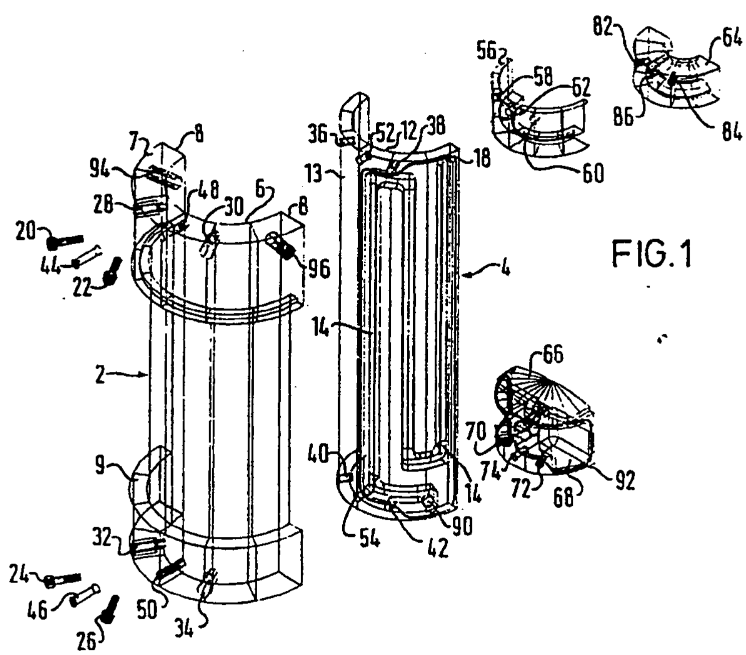

FIG.1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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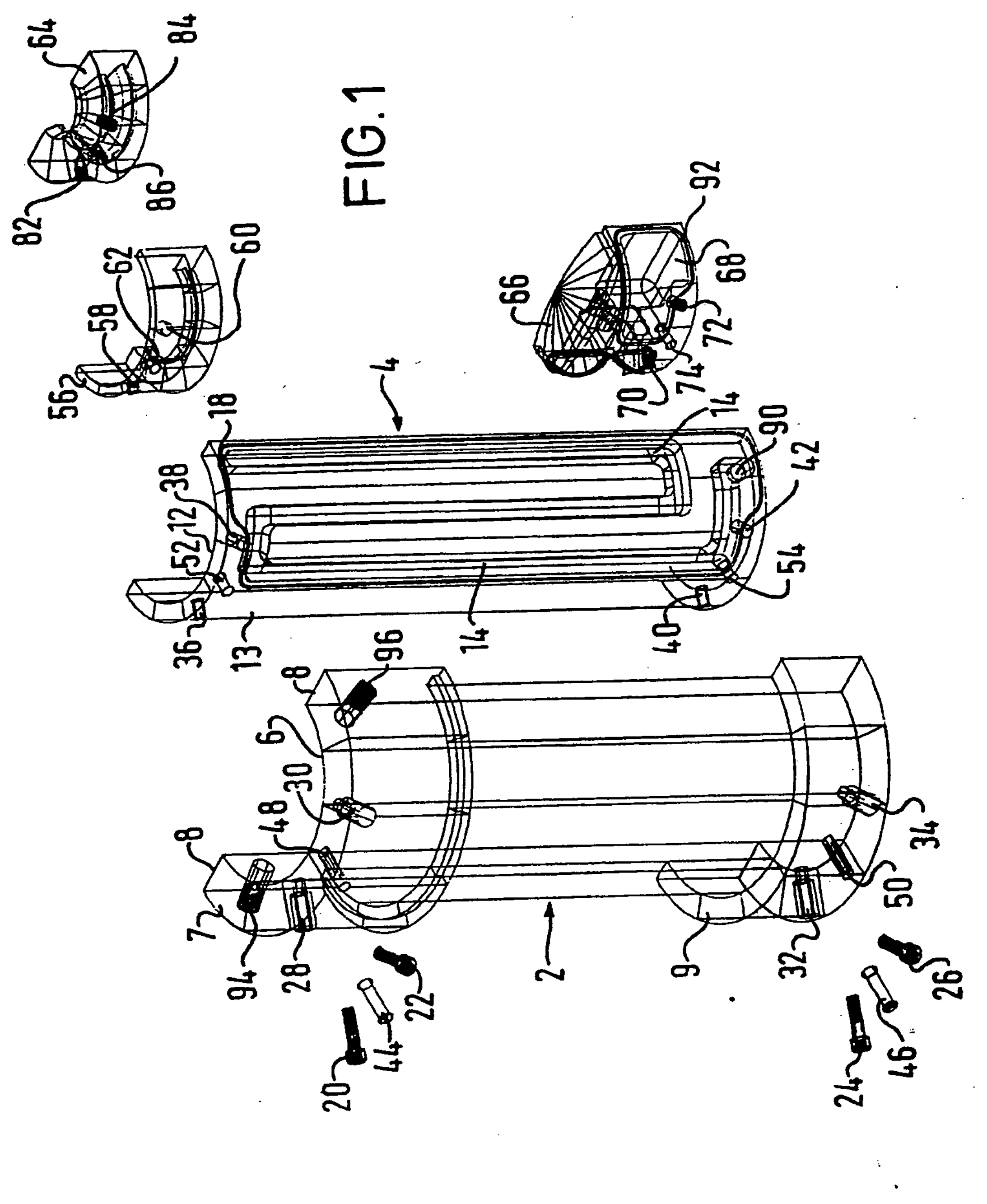
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FIG.1

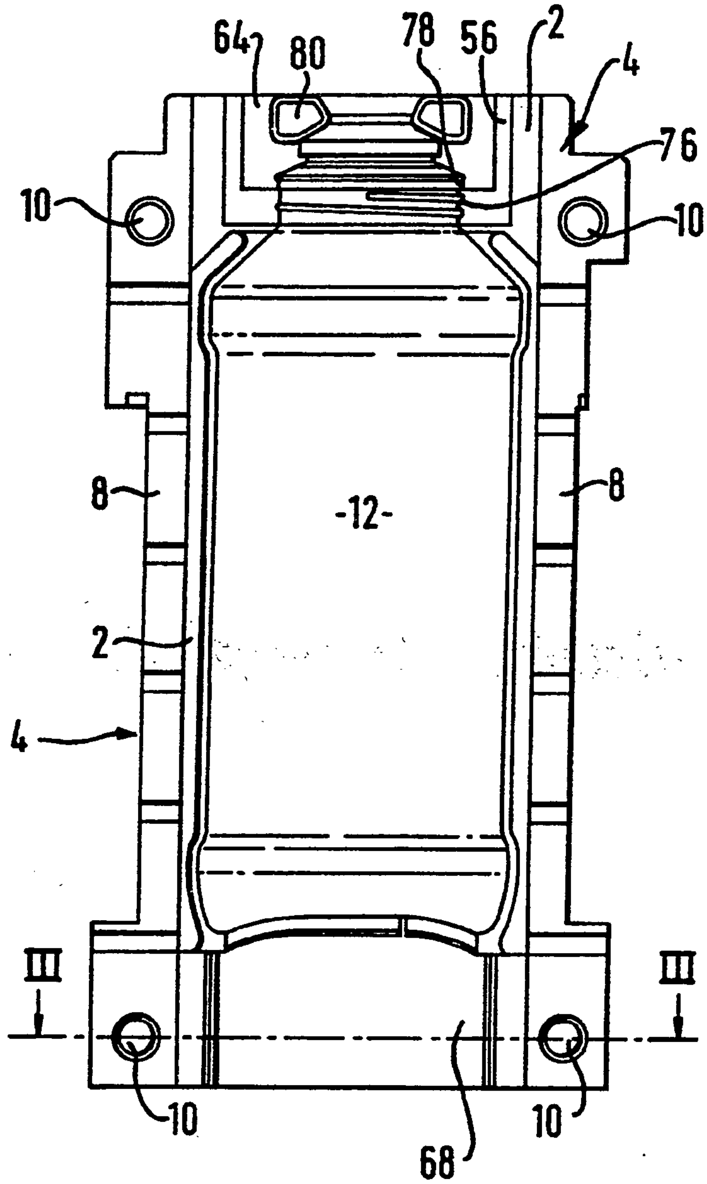

FIG. 2

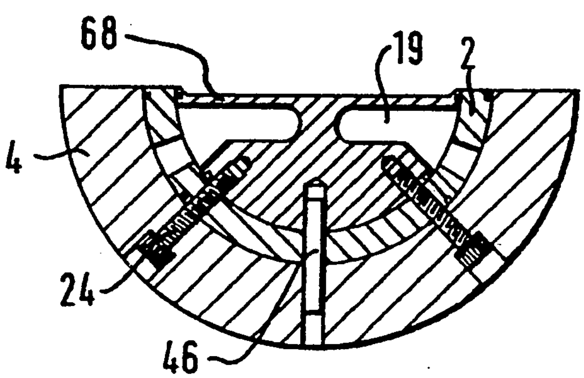

FIG. 3

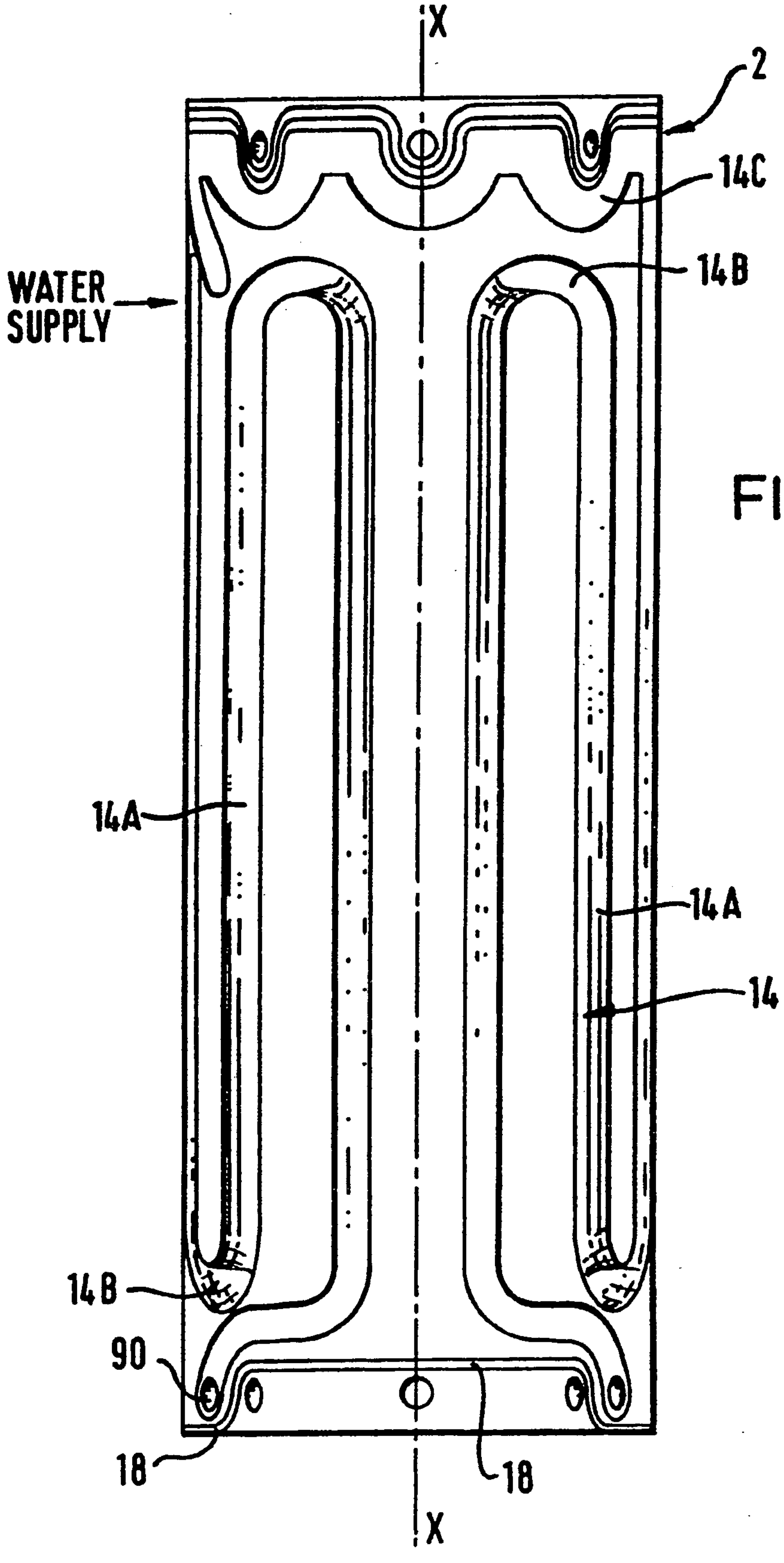

FIG.4

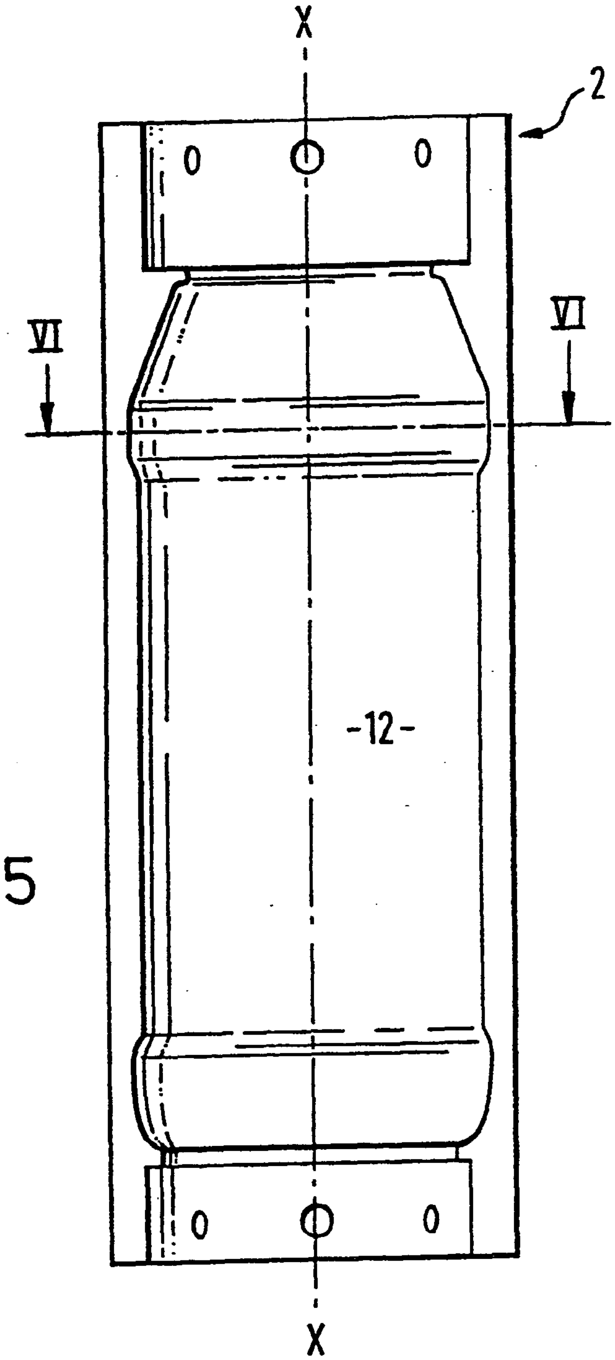

FIG.5

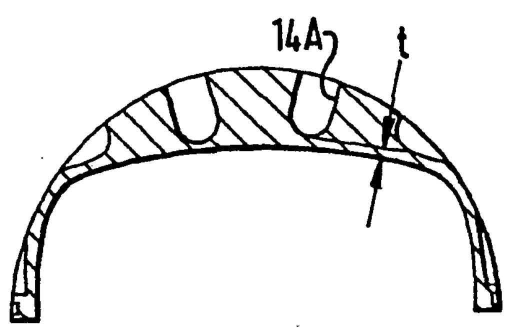

FIG.6

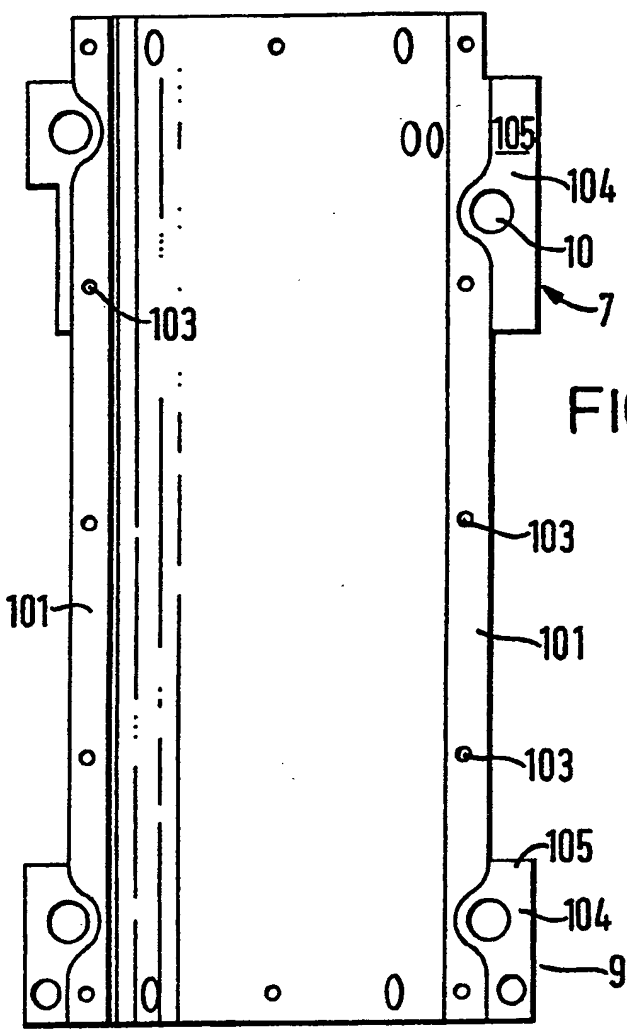

FIG.7

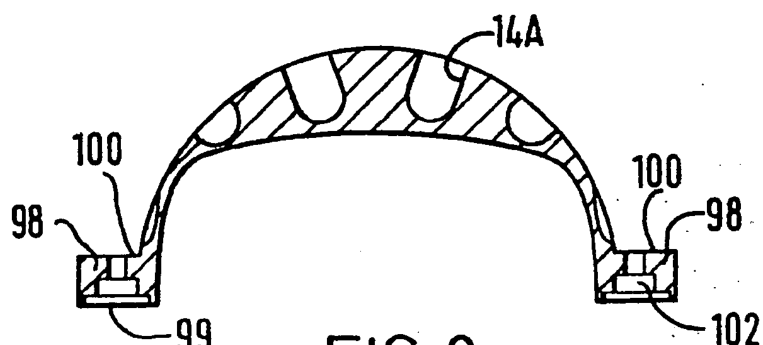

FIG.8

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A MOULD FOR USE IN BLOW MOULDING

This invention relates to a mould for use in blow moulding.

Blow moulds for making hollow plastics articles are split longitudinally into two mould halves which together define the mould cavity. The mould halves are closed together over a hot and flaccid length of extruded tubular parison of a plastics material, after which the parison within the cavity is expanded into conformity with the cavity by pressurised air. The moulded article is then cooled until it is self-supporting, after which the mould halves are separated and the article is ejected.

In an attempt to reduce the overall moulding cycle time to a minimum for high rates of production, the mould is formed with passages through which cooling water is passed. Conventionally, these passages are provided by straight holes drilled in the mould generally in parallel relation to the main axis of the cavity. The cooling effect of water in these passages on the blown article in the mould cavity is far from optimum but this principle has nevertheless been utilised for many years. An additional problem with known moulds is that, with the possible exception of change parts at the top and bottom of the cavity (e.g. to form the threads and base of a bottle) a complete mould incorporating cooling passages is usually needed for each new design of article.

Each time a new design of article is to be blown, a new mould must be secured to the machine and connected up to a supply of cooling water. This can be a lengthy procedure.

The present inventors have sought to increase the efficiency of blow moulding by reducing both the individual mould cycle time and the changeover time between different mould designs, while improving product quality.

In accordance with the present invention there is provided a mould for making a hollow plastics article by blow-moulding in a mould cavity, the mould comprising an outer shell defining a chamber, and an inner shell receivable and locatable within the chamber and itself defining the mould cavity at least in part, the inner shell being formed with cooling fluid channels in its external surface, and the outer shell being arranged to close off the channels so as to define with the inner shell a path for cooling fluid to flow through the mould.

The inner shell thus has the cooling channels formed in its outer surface (but closable by the outer shell), and has the mould cavity defined by a further surface which is separated from the cooling channels by a remanent thickness of the material from which the inner shell is formed. Especially by using CAD/CAM techniques (Computer Aided Design/Computer Aided Manufacture), this remanent material thickness can be readily controlled over substantially the whole of the mould cavity so as to meet the thermal and mechanical requirements of the mould in an optimum manner despite complexities in the shape of the mould cavity. Preferably, the remanent material thickness is set to a constant optimum value chosen to give efficient thermal transfer with adequate mechanical strength. The article is hence cooled more uniformly and efficiently than has hitherto been possible, resulting in improved product quality and a faster cycle time. The known blow moulds cannot provide this facility, because the position of the cooling passages is determined not by

the mould cavity but by manufacturing restrictions; the distance of the water from the mould cavity may therefore necessarily differ considerably and in a non-optimum manner from place to place over the mould.

A further possible advantage of a mould in accordance with the invention is that the outer shell can be arranged for use in common for many different designs of article to be moulded, the inner shell being a "change part" particular to a single article design. The mould unit cost per article can thereby be substantially reduced.

Furthermore, the supply of cooling liquid can be made to the outer shell, which remains fixed, so that the changeover time is reduced.

For a better understanding of the present invention and to show how the same may be carried into effect reference will now be made by way of example to the accompanying drawings, in which:-

Figure 1 is a computer-generated exploded view of one half of a mould in accordance with one embodiment of the invention, showing individually the respective halves of the outer shell, the inner shell, the two neck inserts and the base insert;

Figure 2 is a view from the inside of a further mould half which is largely similar to the mould half shown in Figure 1, after assembly;

Figure 3 is a section on line III-III in Figure 2, showing the base insert and its location in the inner shell;

Figure 4 is a view corresponding to Figure 2 of the inner shell as seen from outside;

Figure 5 likewise shows the inner shell half as seen from inside;

Figure 6 is a section on line VI-VI of Figure 5;

Figure 7 is a view corresponding to Figure 5 of one outer shell half of a further embodiment; and

Figure 8 is a section corresponding to Figure 6 of one inner shell half of the embodiment of Figure 7.

The moulds illustrated herein are each for use in blow moulding, where a parison of a plastics material is located in a mould cavity with its ends secured in neck and base parts of the mould, and pressurised gas is introduced to cause the parison to expand against the mould. An article is hence made in a shape defined by the mould cavity. The principle of blow moulding is well known and will not be described further herein.

Referring now to Figures 1 to 6 of the drawings, a mould for a bottle, for example for a liquid detergent product, is formed of two substantially identical mould halves, each half comprising an inner shell half 4 and an outer shell half 2. The components of one half only of the mould are illustrated, but it is to be understood that the halves of the inner shell together define a mould cavity, and the halves of the outer shell together define a chamber for receiving the inner shell.

Each outer shell half 2 is generally semicylindrical in form, having an inner surface 6 which is semicylindrical except where it is formed with apertures. At its top and

bottom ends the shell half 2 is enlarged in the radially outward direction, its enlargements being respectively denoted 7 and 9.

The inner shell half is also of a generally semicylindrical form and has an inner surface 12 defining half of the mould cavity which determines the shape of an article to be blown in the mould.

The outer surface 13 of the inner shell half is essentially semicylindrical but formed with open cooling channels 14 which are shown in greater detail in Figure 4 and are interconnected to form a cooling fluid flow path as will be described. The surface 13 is dimensioned to fit snugly against the inner surface 6 of the outer shell half 2 so that the surface 6 closes off the cooling channels. A sealing strip 18 is located in a groove formed in the outer surface 13 of the inner shell half 4 to define a sealed area which contains the cooling channels and which is closed off when the shell halves are assembled together.

For forming the thread of the bottle the mould has a first neck insert half 56 which is located within a semicylindrical recess formed at the top of the inner shell half 4 above its mould cavity surface 12. The first neck insert half 56 serves to receive and locate a second neck insert half 64 by which a pulley for supporting the moulded bottle for ejection is to be formed. The parting line along which the bottle is later to be severed from the neck moil or scrap (including the pulley) is formed adjacent the interface of the two neck inserts.

A further semicylindrical recess formed at the bottom of the inner shell half below the mould cavity surface 12 serves to receive and locate a base insert half 68 having

a domed surface 66 by which the base of the bottle is to be defined.

At the top of the mould the shell halves 2,4 and the neck insert halves 56,64 are attached securely together by a pair of bolts 20,22 (Figure 1) which extend through clearance holes 28 and 30, 36 and 38, 58 and 60 in the items 2,4 and 56 respectively, to threaded holes 82,84 in the neck insert half 64. Likewise at the bottom end of the mould the shell halves and the base insert half are attached together by bolts 24,26 passing through clearance holes 32 and 34, 40 and 42 to threaded holes 70,72 in the base insert half.

During assembly or dismantling of the mould half, location of its individual components in relation to one another is assisted or provided by a dowel 44 fitted in holes 48,52,62 and 86 at the top of the mould, and a further dowel 46 fitted in holes 50,54 and 74 at the bottom of the mould.

The inner shell half 4 is shown in more detail in Figures 4 to 6. In particular, Figure 4 shows the open cooling channels 14 which are formed in the outer surface of the inner shell half.

As will become apparent, the channels are interconnected in series to form a fluid flow path for the mould half. They include six axially extending, parallel channels 14A which extend for a major part of the length of the inner shell half, and arcuate channels 14B which interconnect the axial channels to form two sections of the flow path which generally are mirror images of one another on either side of the central plane XX (Figures 4,5) of the shell half.

The two flow path sections, which for clarity are not separately referenced, are interconnected at the bottom of the mould half by a passageway 19 which extends through the base insert half 68 so as to provide localised cooling at the base of the mould cavity. Connections are made to this passageway from the two flow path sections through holes 90 (Figures 1,4) extending through the wall of the inner shell half. Strips 92 similar to the strip 18 surround the entry and exit ends of the passageway on the surface of the base insert half for sealing purposes.

In the assembled mould half shown in Figure 1, the fluid flow path is completed by threaded holes 94,96 which are formed through the outer shell half 2 at the free ends provided by the outermost axial passages 14A, for connection into a suitable external cooling fluid (e.g. water) supply circuit. The mould half shown in Figures 2 to 6 differs in one respect in having one of its flow path sections continued as a sinuous channel 14C which extends around the top end of the inner shell half 4 to provide localised cooling for the top end of the mould cavity. By virtue of the channel 14C the ends of the fluid flow path in the embodiment of Figures 2 to 6 brought conveniently adjacent one another; they are completed by threaded holes (not shown) corresponding to the holes 94,96 and likewise formed through the outer shell half.

Although not apparent from Figure 1, it is to be understood that suitable means are provided for locating the halves of each featured mould in relation to one another for their operation to mould plastics articles. For this purpose the mould halves illustrated in Figures 2 to 6 have pins on one mould half arranged for engagement in bushed holes in the other mould half: in Figure 2 the

pins or holes, as appropriate, are denoted by the reference numeral 10.

As can be understood from Figure 6, the channels 14A, 14B and 14C have a varying depth and cross-section, although generally they have a rounded bottom, and sides which are directed radially of the mould. The depth of each channel varies according to its position, so as to maintain a constant remanent thickness of metal between the cooling liquid and the blown article in the mould cavity which is to be cooled. This ensures substantially uniform optimum cooling of the article, which improves product quality and reduces cycle times. The remanent thickness, which is represented in Figure 6 by the letter "t", is typically 2mm.

The precise configuration and depth of the channels can be varied in the manufacture of different inner shells to suit different articles. It is a considerable advantage of the present invention that the channel configuration of an inner shell for a particular article can be designed using computer aided techniques and subsequently machined using computer controlled machine tools operating in accordance with the design program. This enables the base of the channels to follow the contour of the mould cavity for any shape of mould cavity and irrespective of the shape of the inner shell half outer surface.

The channels 14 are closed off by the simple, semicylindrical inner surface 6 of the outer shell 2, and it is possible to utilise a common outer shell 2 for several different inner shells having different channel configurations and mould cavities but with the same outer surface contour. This is advantageous since, in the blow moulding machine to which the mould is attached, the outer shells of the mould can remain fixed to the machine with

the supply of cooling fluid permanently connected thereto, and only the inner shells and inserts need to be replaced to mould a different article of the same general dimensions. This decreases the "change-over" time for the blow moulding machine.

Figures 7 and 8 illustrate the arrangement of a third embodiment of the invention, which can be considered as a modification of the embodiment of Figures 2 to 6. Each inner shell half of this further embodiment has an outturned flange 98 formed along each of its side edges. The two flanges are coplanar, and arranged for their front faces 99 to form part of the interface between the halves of the assembled mould. The back faces 100 of the flanges are arranged to abut the side edges 101 of the outer mould shell half when the outer and inner shell halves are assembled together. Reamed and counterboard holes 102 are formed at spaced intervals along each flange, in alignment with reamed threaded holes 103 in the outer shell half. Shoulder screws (not shown) having their heads received in the holes 102 are screwed into the outer shell half to attach and locate the shell halves securely together along their length. The flanges 98 contribute substantially to the strength of the mould half, and therefore increase its ability to withstand moulding and coolant pressures; in contrast, in the embodiments previously described the outer and inner shell halves are secured together only at their top and bottom ends, and some distortion may occur during moulding.

In this further embodiment engagement between the outer shell halves only occurs at their enlargements 7 and 9. The enlargements have projections 104 the front faces 105 of which are nearly coplanar with the faces 99 of the inner shell half so as to present their pins and bushed holes 10 for engagement with one another.

Whilst in the embodiments of the invention described above, the surfaces at which the outer shells interface with the inner shells to close the channels 14 are simple, that is to say, they are of a regular geometric form and have no open channels formed in them, the invention includes within its scope mould arrangements in which the outer shell is formed with channels which are additive to, or instead of, channels formed in the inner shell. Whilst the availability of the outer shell for use with any one of a plurality of inner shells having different mould cavities may thereby be reduced, the separability of the mould at the cooling fluid flow path is retained, and cooling efficiency can therefore be substantially optimised as before, particularly by use of computer-controlled design and manufacture techniques.

In a variation of the described mould arrangements the cooling fluid flow path is extended into the neck insert region so as to provide more efficient cooling in that locality.

CLAIMS:

1. A mould for making a hollow plastics article by blow-moulding in a mould cavity, the mould comprising an outer shell defining a chamber, and an inner shell receivable and locatable within the chamber and itself defining the mould cavity at least in part, the inner shell being formed with cooling fluid channels in its external surface, and the outer shell being arranged to close off the channels so as to define with the inner shell a path for cooling fluid to flow through the mould.

2. A mould as claimed in claim 1, wherein the inner surface of the inner shell defining the mould cavity is separated from the cooling channels by a substantially constant remanent thickness of material.

3. A mould as claimed in claim 1 or 2 comprising, secured to the inner shell, at least one neck insert for defining the neck region of the article to be moulded and a base insert for defining the base region of the article to be moulded.

5. A mould as claimed in any preceding claim wherein the inner and outer shells, and the neck and base inserts when present, are each formed in two substantially identical halves.

5. A mould as claimed in any preceding claim wherein the inner surface of the outer shell is a simple surface.

6. A mould substantially as hereinbefore described with reference to or as shown in the accompanying drawings.